

WHAT IS CLAIMED IS:

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1. A method to disaggregate asphaltenes in petroleum oils and oil mixtures comprising mild heating.
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2. The method of claim 1 further comprising the step of determining the presence of asphaltene aggregates by irradiating said petroleum oils and oil mixtures with neutrons and determining small angle neutron scattering (SANS) intensity, I , as a function of wavenumber, q .
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3. The method of claim 2 wherein said neutron scattering wavenumber, q , is in the range $10^{-4} \text{ \AA}^{-1} \leq q \leq 1 \text{ \AA}^{-1}$, preferably $10^{-3} \text{ \AA}^{-1} \leq q \leq 10^{-1} \text{ \AA}^{-1}$.
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4. A method to determine the regimes of compatibility and incompatibility of petroleum oils and mixtures of petroleum oils and/or refinery process streams using fitting of $I(q)$ in claim 2 to an equation based on a physical model that contains contributions a strongly decaying feature to describe the surface scattering of asphaltene aggregates at low q , a plateau feature with a rolloff at higher q to describe the asphaltene particles, and a constant to describe
20 the high q incoherent scattering.
5. The method of claim 4 wherein the equation is given by Equation (1).
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6. The method of claim 5 wherein the criterion for incompatibility is determined by the concavity of the low- q plateau intensity of the asphaltene particles, I_L , as a function of the volume fraction of mixing, ϕ_m .

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7. The method of claim 5 wherein the criterion for incompatibility is determined by the systematic deviation of I_L , as a function of mixing volume fraction from the hard sphere prediction given by Equation (2).
- 5 8. The method of claim 5 wherein the criterion for incompatibility is determined by the maximum in the correlation length, given by Equation (2).
- 10 9. The method of claim 5 wherein the criterion for incompatibility is determined by the dominance of the low- q value of the surface scattering intensity, I_{surf} , over the sum of the low- q plateau intensity of the asphaltene particles and the incoherent scattering intensity.
- 15 10. The method of claim 5 wherein the criterion for incompatibility is determined by the power law exponent, α , exceeding a value of three.
- 20 11. A method to estimate the volume fraction of asphaltene aggregates, ϕ_{agg} , in incompatible petroleum oil and/or refinery process stream mixtures based on a difference between the low- q plateau intensity corresponding to the asphaltene particles, I_L , determined in claim 5 at different volume fractions of mixing, ϕ_m , and a prediction for the behavior of this intensity expected for spherical particles interacting by contact repulsions.
- 25 12. The method of claim 11 wherein the equation to estimate the volume fraction of aggregates, ϕ_{agg} , is given by Equations (2) and (3).

13. The method of claim 2 wherein the total surface area of asphaltene aggregates per unit volume of the petroleum oil, S_V , is determined from the amplitude of the surface scattering intensity, I_{surf} , from asphaltene aggregates at low wavenumbers, q .

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14. The method of claims 12 and 13 wherein the average length scale, R , associated with the internal structures of the asphaltene aggregates is estimated using Equation (4).

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